MID- AND LONGWAVE INFRARED TOTAL AND DIFFUSE REFLECTANCE MEASUREMENTS USING AN INTEGRATING SPHERE WITH A TWO-SAMPLE-PORT DESIGN

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We report here improved methodologies for the use of the Bruker A 562-G integrating sphere for quantitative total and diffuse reflectance measurements. The sphere has an internal diameter of 75 mm and the interior surface is coated with matte gold. It has an input port (20 mm diameter), top (32 mm) and bottom (19 mm) sample ports, all on a sphere circumference defined by a vertical plane than includes the sphere center, and a baffled port (10 mm) for an MCT detector (2 mm x 2 mm), that is on a sphere circumference defined by a horizontal plane that includes the sphere center. An interior flip mirror is used to direct light from the input port to either the top or bottom sample ports. The sphere sits in the sample compartment of a benchtop Fourier transform spectrometer. Total reflectance measurements are made by placing the sample in one of the sample ports and blocking the other sample port with a matte gold reference material, recording spectra with the flip mirror pointed towards the sample and then towards the reference material, and then ratio-ing the two spectra. Using this method excellent agreement ($< 2\%$ difference) was observed between measurements made using the Bruker sphere and FTIR and reported values for five NIST-calibrated total reflectance standards. Diffuse reflectance measurements are made by placing the sample in one of the sample ports and leaving the other port open to allow the specular reflection component of the sample to exit the sphere, recording spectra with the flip mirror pointing towards the sample and then towards a point on the sphere wall. The two spectra are again ratioed. The diffuse spectrum is thus the total spectrum less the specular component. In the shortwave infrared, where there is sufficient overlap, total and diffuse measurements using the Bruker sphere and FTIR compare favorably with results from a Varian Spectralon-coated integrating sphere and Cary 5000i spectrometer for a number of different materials.